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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1 53(b))

Attorney Docket No.	10862-0001-2
First Inventor or Application Identifier	Jong Uk CHOI, et al.
Title	DIGITAL WATERMARKING METHOD AND APPARATUS

APPLICATION ELEMENTS
See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. ■ Fee Transmittal Form (e.g. PTO/SB/17)
(Submit an original and a duplicate for fee processing)

2. ■ Specification — Total Pages: 21

3. ■ Drawing(s) *(35 U.S.C. 113)* — Total Sheets: 2

4. ■ Oath or Declaration — Total Pages: 4
   a. ■ Newly executed (original)
   b. □ Copy from a prior application *(37 C.F.R. §1.63(d))*
   (for continuation/divisional with box 15 completed)
      i. □ DELETION OF INVENTOR(S)
      Signed statement attached deleting inventor(s) named in the prior application, see *37 C.F.R. §1.63(d)(2) and 1.33(b).*

5. □ Incorporation By Reference *(usable if box 4B is checked)*
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4B, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

ACCOMPANYING APPLICATION PARTS

6. ■ Assignment Papers (cover sheet & document(s))
7. □ 37 C.F.R. §3.73(b) Statement *(when there is an assignee)* □ Power of Attorney
8. □ English Translation Document *(if applicable)*
9. □ Information Disclosure Statement (IDS)/PTO-1449 □ Copies of IDS Citations
10. □ Preliminary Amendment
11. ■ White Advance Serial No. Postcard
12. ■ Small Entity Statement(s) □ Statement filed in prior application. Status still proper and desired.
13. □ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
14. ■ Other: Notice of Priority

15. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below:*
□ Continuation □ Divisional □ Continuation-in-part (CIP) of prior application no.:
Prior application information: Examiner: Group Art Unit:

16. Amend the specification by inserting before the first line the sentence:
□ This application is a □ Continuation □ Division □ Continuation-in-part (CIP)
of application Serial No. Filed on

□ This application claims priority of provisional application Serial No. Filed

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Name:		Registration No.:	

Patent
Attorney's Docket No. 10862-0001-2

Applicant or Patentee: MARKANY INC.

Serial or Patent No.: New Application

Filed or Issued: Herewith

For: DIGITAL WATERMARKING METHOD AND APPARATUS

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 C.F.R. §§ 1.9(f) AND 1.27(c)) - SMALL BUSINESS CONCERN

I hereby declare that I am

[ ] the owner of the small business concern identified below:
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ADDRESS OF CONCERN _____

_____

I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 13 C.F.R. §§ 121.3-18, and reproduced in 37 C.F.R. § 1.9(d), for purposes of paying reduced fees under Sections 41(a) and 41(b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average, over the previous fiscal year of the concern, of the persons employed on a full-time, part-time, or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention entitled _____

_____

by inventor(s) _____

described in

[X] the specification filed herewith
[ ] Application Serial No. _____, filed _____
[ ] Patent No. _____, issued _____.

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NAME _____

ADDRESS _____

[ ] individual [ ] small business concern [ ] nonprofit organization

NAME ____________________

ADDRESS ____________________

[ ] individual [ ] small business concern [ ] nonprofit organization

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earlier of the issue fee and any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 C.F.R. § 1.28(b).)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code; and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

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TITLE OF PERSON OTHER THAN OWNER Representative

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SIGNATURE [signature] DATE March 21, 2000

(BDSM 11)
(12/91)

DIGITAL WATERMARING METHOD AND APPARATUS

BACKGROUND OF THE INVENTION

1. Technical Field

The present invention relates to digital watermarking of data, including audio, video, and multimedia data. Specifically, the invention relates to embedding a watermark signal into digital audio data.

2. Description of the Related Art

The proliferation of digitized media such as image, video and multimedia is creating a need for security system which facilitates the identification of the source of the material. Particularly, the internet is increasingly used for transmitting recorded music in a digitized format. Content providers, i.e., owners of such recorded music in digital form, have a need to embed into multimedia data a predetermined mark which can subsequently be detected by software and/or hardware devices for purposes of authenticating copyright ownership, control and management of the multimedia data. Digital watermarking has been developed as a technique for embedding an identifiable data into multimedia data.

Conventionally, a watermark signal used for watermarking audio signal has

been relatively simple signals such as a sequence of code symbols because, unlike image or video, inserting a large watermark signal would affect original audio perceptibility. Therefore, a watermarking technique employing a large image as a watermark signal has been proposed. However, prior arts watermarking techniques involving an image watermark are susceptible to unauthorized removal of watermarks, thereby making hard to trace the origin of a copyright protected material.

SUMMARY OF THE INVENTION

An objective of the present invention is to provide a digital watermarking technique that does not allow easy removal by an unauthorized person of a watermark signal embedded in digital data, particularly audio signal data and yet minimize distortion of original data. The objective is achieved in part by correlating the coefficients of wavelet transformation of magnitudes of Fourier transformed audio signal with the coefficients of discrete cosine transformed watermark signal. The coefficients of transformed audio signal data and scaled-down coefficients of watermark signal are added, inverse wavelet transformed and inverse Fourier transformed to produce watermarked audio signal data.

In accordance with one aspect of the present invention, a method for inserting a watermark signal into audio signal data comprises the steps of: Fourier transforming audio signal data in the frequency domain in a form of first components and second components; wavelet transforming absolute values of the

first components to generate first spectral coefficients; discrete cosine transforming a watermark signal to generate second spectral coefficients; combining the first spectral coefficients and the second spectral coefficients; and Inverse wavelet transforming the combined coefficients.

The first components and second components may be the magnitudes and phases of coefficients respectively. Preferably, the step of combining includes a step of performing a weighted addition of the first and second spectral coefficients. It is preferable for the method to further comprise a step of inverse Fourier transforming the output of the inverse wavelet transforming by using the phases of coefficients. Also, it is preferable for the method to further comprise a step of multiplying information from the first spectral coefficients to the second spectral coefficients prior to the combining step. Further, the method may comprise a step of multiplying a scaling factor to the second spectral coefficients prior to said combining step. The scaling factor may be in the range of 0.01 ~ 0.05. Preferably, the information is a function of the sign of the first spectral coefficients.

In accordance with another aspect of the present invention, a method for extracting a watermark from a watermark-embedded audio data comprises the steps of Fourier transforming a watermark-embedded audio data and an original audio data to generate the first components and the second components respectively; Wavelet transforming the absolute magnitudes of the first components of the watermark-embedded audio data and the original audio data, respectively; taking the differences between wavelet-transform coefficients of the

watermark-embedded audio data and the original audio data; and inverse-discrete cosine transforming the differences.

Preferably, the method further comprise a step of multiplying the sign of the wavelet-transform coefficients associated with the original audio data to wavelet-transform coefficients associated with the watermark-embedded audio data. Further, the multiplying step may comprise a step of multiplying a scaling factor to wavelet coefficients associated with the watermark-embedded audio data. The sign may be obtained by using a signum function. The scaling factor may be in the range of 20 ~ 100.

BRIEF DESCRIPTION OF THE DRAWINGS

The aforementioned aspects and other features of the invention will be explained in the following description, taken in conjunction with the accompanying drawings wherein:

Fig. 1 is a block diagram for inserting a watermark signal into audio signal data according to the present invention; and

Fig. 2 is a block diagram for extracting a watermark signal from the watermark embedded audio signal data.

DETAILED DESCRIPTION OF THE PREFERRED INVENTION

Referring to Fig.1, a digital watermarking method and system according to

the present invention will be described.

When a watermark signal is transformed using a transformation scheme, the shape of the original watermark is not preserved. The present invention is based on the idea that a watermark of an impulse type is hard to delete because the watermark, after inventive transformations, would be distributed over the whole transform plane. Thus it helps to prevent unauthorized copying of a legitimate data.

Among many transformation schemes, the present invention employs DCT to transform a watermark, because coefficients of DCT transformed plane are real values, whereas coefficients of Fourier-transformed plane have complex components, making it more difficult to match with original image data.

When inserting a watermark (W) into original audio data (S) to form a watermark-embedded audio data (S'), the quality of the watermark-embedded audio data (S') can be controlled by adjusting the interval between the original audio data (S) and the watermark (W) using a scaling parameter α, as shown in Eq. 1.

[Equation 1]

$$S'_i = S_i + \alpha W_i \qquad Eq.1a$$

$$S'_i = S_i(1 + \alpha W_i) \qquad Eq.1b$$

$$S'_i = S_i(e^{\alpha W_i}) \qquad Eq.1c$$

Eq. 1a is always invertible. Eqs. 1b and 1c are invertible when Wi ≠ 0. If Eqs. 1b and 1c are employed, the security of watermarks may not be maintained for various processes in multimedia applications. Thus, the present invention utilizes Eq. 1a.

Figs. 1 and 2 show processes of watermarking original digital data and extracting the watermarks, in accordance with the present invention. Referring to Fig. 1, a process of watermarking original digital data will be described.

When original audio data to embed a watermark is inputted to processing means (not shown in the figure), the processing means Fourier-transforms the original audio data by using a predetermined algorithm to generate amplitude and phase components. A Fourier Series is used for the Fourier transform, as follows:

[Equation 2]

$$X_n = \frac{1}{T_o}\int_{T_o} x(t)e^{-j2\pi nf_o t}dt$$

$$x(t) = \sum_{n=-\infty}^{\infty} X_n e^{j2\pi nf_o t}$$

The process of Fourier-transforming a continuous function f(x) using the infinite series of Eq. 2 may be defined as Eq. 3.

[Equation 3]

$$X(f) = \int_{-\infty}^{\infty} x(t) e^{-j2\pi ft} dt$$

$$x(t) = \int_{-\infty}^{\infty} X(f) e^{j2\pi ft} df$$

For example,

$$X(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT_o)$$

$$X_n = \frac{1}{T_o} \int_{-8T_o}^{8T_o} \delta(t - 5T_o) e^{-j2\pi nf_o t} dt$$

$$= \frac{1}{T_o} \qquad \leftarrow \quad f_o T_o = 1$$

$$x(t) = \sum_{n=-\infty}^{\infty} X_n e^{-j2\pi nf_o t}$$

$$= \frac{1}{T_o} \sum_{n=-\infty}^{\infty} e^{-j2\pi nf_o t}$$

$$X(f) = \int_{-\infty}^{\infty} \sum_{n=-\infty}^{\infty} \delta(t - nT_o) e^{-j2\pi ft} dt$$

$$= \sum_{n=-\infty}^{\infty} \int_{-\infty}^{\infty} \delta(t - nT_o) e^{-j2\pi ft} dt$$

$$= \sum_{n=-\infty}^{\infty} e^{-j2\pi nfT_o}$$

$$= \int_{-\infty}^{\infty} \frac{1}{T_o} \sum_{n=-\infty}^{\infty} e^{-j2\pi nf_o t} e^{-j2\pi ft} dt$$

$$= \frac{1}{T_o} \sum_{n=-\infty}^{\infty} \int_{-\infty}^{\infty} e^{-j2\pi (f + nf_o)t} dt$$

$$= \frac{1}{T_o} \sum_{n=-\infty}^{\infty} \delta(f + nf_o)$$

where

$$\sum_{n=-\infty}^{\infty} \delta(t - nT_o) \quad \leftarrow \rightarrow \quad f_o \sum_{n=-\infty}^{\infty} \delta(f + nf_o)$$

$$\sum_{n=-\infty}^{\infty} \delta(t - nT_o) = \frac{1}{T_0} \sum_{n=-\infty}^{\infty} e^{-j2\pi nf_o t}$$

$$\sum_{n=-\infty}^{\infty} \delta(f - nf_o) = \frac{1}{f_0} \sum_{n=-\infty}^{\infty} e^{-j2\pi nfT_n}$$

$$\sum_{n=-\infty}^{\infty} \delta(f - n) = \sum_{n=-\infty}^{\infty} e^{-j2\pi nf} \leftarrow T_0 = f_o = 1$$

In the Fourier transform as defined in Eq.3, it is preferable to use complex values, since a complex value may represent both the amplitude and phase at a time, as shown below.

[Equation 4]

$$F(u) = R(u) + jI(u)$$
$$F(u) = |F(u)|e^{j\phi(u)}$$

In Eq. 4, Fourier spectrum is expressed as:

$$|F(u)| = \left[R^2(u) + I^2(u)\right]^{\frac{1}{2}}$$

the phase is expressed as:

$$\phi(u) = \tan^{-1}\left[\frac{I(u)}{R(u)}\right]$$

the power spectrum is expressed as:

$$P(u) = |F(u)|^2 = R^2(u) + I^2(u)$$

where u represents a variable for frequency.

By employing Euler's equation, i.e., $\exp[-j2\pi ux] = \cos 2\pi x - j\sin 2\pi x$, the Fourier transform can be represented by the equation defined in Eq. 5.

[Equation 5]

$$T\{f(x,y)\} = F(u,v) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(x,y)\exp[-j2\pi(ux+vy)]dxdy$$
$$T^{-1}\{f(u,v)\} = F(x,y) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(u,v)\exp[j2\pi(ux+vy)]dudv$$

Therefore, the Fourier spectrum, phase, and power spectrum can be given as follows:

Fourier spectrum:

$$|F(u,v)| = [R^2(u,v) + I^2(u,v)]^{\frac{1}{2}}$$

Phase:

$$\Phi(u,v) = \tan^{-1}\left[\frac{I(u,v)}{R(u,v)}\right]$$

Power spectrum:

$$P(u,v) = |F(u,v)|^2 = R^2(u,v) + I^2(u,v)$$

As shown above, Fourier transform employs infinite series to transform analog signals to sampled digital signals. However, in order to implement

Fourier transform by a computer, modified Fourier transform for sampled data, i.e., Discrete Fourier Transform (DFT) is used on behalf of Fourier transform. If DFT is employed, f(x) can be given as Eq. 6.

[Equation 6]

$$X[m] = \sum_{n=0}^{N-1} x[n] e^{-j\frac{2\pi mn}{N}}, \quad m[0, N-1]$$
$$= X(e^{-j\frac{2\pi m}{N}}),$$

$$x[n] = \sum_{m=0}^{N-1} X[m] e^{j\frac{2\pi mn}{N}}, \quad n[0, N-1]$$

Also,inverseDFT $X(e^{\frac{2\pi m}{N}})$ is defined as Eq. 7, when the rotational initial and maximum value is X[n].

[Equation 7]

$$x[n]_N = \sum_{m=0}^{N-1} X(e^{\frac{2\pi m}{N}}) e^{j\frac{2\pi mn}{N}}$$
$$= \sum_{k=-\infty}^{\infty} x[n-kN] \quad : Period \quad N$$

Digital audio data is Fourier transformed at a Fourier transformer 10 as described above while a watermark signal is discrete cosine transformed at a discrete cosine transformer 14. Next, the magnitudes of the coefficients of Fourier transformed audio data, obtained by a magnitude extractor 11, are wavelet transformed at a wavelet transformer 13. Now the signs (+, -, 0) of the audio's coefficients are respectively multiplied to the spectral coefficients of the watermark signal at the first multiplier 31 in order to correlate the audio signal and the watermark signal to certain extent. The sign can be easily obtained by using the signum function unit 15, which outputs 1, -1 or 0 depending on the sign/polarity of an input value disregarding the magnitude. The spectral coefficients of the watermark signal are further multiplied by a scaling factor α at the second multiplier 32 so as not change the audio signal's quality as perceived by the listener. The scaling factor is preferably in the range of 0.01 to 0.05. In other words the influence of the scaled watermark signal's coefficients on the spectral shape of the audio data is minimized so that watermark-embedded audio signal is perceptively no different from the original audio signal from the perspective of the listener. The scaled coefficients are then added to the coefficients of wavelet transformed audio signal data at an adder 30. The added coefficients are inverse wavelet transformed at an inverse wavelet transformer 16 to generate adjusted coefficient magnitudes. Finally, the adjusted magnitudes, generated by the inverse wavelet transformer, and the phase component of the audio signal data, obtained by a phase extractor 12, are input to an inverse

Fourier transformer 17 to finally generate watermark-embedded audio data.

Next a watermark extraction from a watermark-embedded audio data will be described referring to Fig. 2. A watermark-embedded audio data undergoes a Fourier transform at a Fourier transformer 20 to generate a first set of coefficients in the frequency domain. Simultaneously or independently an original audio data is also Fourier transformed at a Fourier transformer 23 to generate a second set of coefficients in the frequency domain. The magnitudes of the two set of coefficients, obtained by magnitude extractors 21 and 24 respectively, are further wavelet transformed at wavelet transformers 22 and 25 respectively. The wavelet coefficients associated with the original audio data are subtracted from those with the watermark-embedded audio signal at a subtracter 33. The differences in the coefficients are multiplied by a scaling factor ($1/\alpha$) and the sign (1 for positive, 0 for none and -1 for negative) of the wavelet transform coefficients associated with the original audio data at a multiplier 34. The sign can be obtained by using a signum function unit 26. Finally, the scaled coefficients, multiplied by the output of the signum function unit 26 is inverse discrete cosine transformed at an inverse discrete cosine transformer 27 to produce a watermark which had been embedded in the original audio data.

The watermarking method described above can be implemented on a single chip integrated circuit or discrete components. Specifically, a digital signal processor may be programmed to perform the steps in the inventive watermarking.

While there has been described and illustrated a method and system for

inserting a watermark data by discrete cosine transforming the watermark signal and Fourier/wavelet transforming an original audio data, it will be apparent to those skill in the art that variations and modifications are possible without deviating from the broad principles and teachings of the present invention which shall be limited solely by the scope of the claims appended hereto.

What is claimed is:

1. A method for inserting a watermark signal into audio signal data, comprising the steps of:

Fourier transforming audio signal data in the frequency domain in a form of first components and second components;

wavelet transforming absolute values of said first components to generate first spectral coefficients;

discrete cosine transforming a watermark signal to generate second spectral coefficients;

combining said first spectral coefficients and said second spectral coefficients; and

Inverse wavelet transforming the combined coefficients.

2. The method for inserting a watermark signal into audio signal data as claimed in claim 1, wherein said first components and second components are the magnitudes and phases of coefficients respectively.

3. The method for inserting a watermark signal into audio signal data as claimed in claim 1, wherein said step of combining includes a step of performing a weighted addition of said first and second spectral coefficients.

4. The method for inserting a watermark signal into audio signal data as

claimed in claim 3, further comprising a step of inverse Fourier transforming the output of said inverse wavelet transforming by using said phases of coefficients.

5. The method for inserting a watermark signal into audio signal data as claimed in claim 4, further comprising a step of multiplying an information from said first spectral coefficients to said second spectral coefficients prior to combining step.

6. The method for inserting a watermark signal into audio signal data as claimed in claim 5, further comprising a step of multiplying a scaling factor to said second spectral coefficients prior to said combining step.

7. The method for inserting a watermark signal into audio signal data as claimed in claim 6, wherein said scaling factor is in the range of 0.01 ~ 0.05.

8. The method for inserting a watermark signal into audio signal data as claimed in claim 5, wherein said information is a function of the sign of said first spectral coefficients.

9. An apparatus for inserting a watermark signal into audio signal data, comprising:

a means for Fourier transforming audio signal data into amplitude components and phase components;

a means for wavelet transforming absolute values of said amplitude components to generate first spectral coefficients;

a means for discrete cosine transforming a watermark signal to generate second spectral coefficients;

a means for combining said second spectral coefficients to said first spectral coefficients respectively; and

inverse wavelet transforming the coefficients.

10. The apparatus for inserting a watermark signal into audio signal data as claimed in claim 9, wherein said combining means comprises a means for multiplying an information from said first spectral coefficients to said second spectral coefficients.

11. The apparatus for inserting a watermark signal into audio signal data as claimed in claim 10, wherein said combining means comprises a means for multiplying a scaling factor to said second spectral coefficients.

12. The apparatus for inserting a watermark signal into audio signal data as claimed in claim 11, wherein said scaling factor is in the range of 0.01 ~ 0.05.

13. The apparatus for inserting a watermark signal into audio signal data as claimed in claim 9, further comprising a means for inverse Fourier transforming said respectively combined coefficients using said phase components.

14. The apparatus for inserting a watermark signal into audio signal data as claimed in claim 10, wherein said information is a function of the sign of said first spectral coefficients.

15. A method for extracting a watermark from a watermark-embedded audio data, comprising steps of:

Fourier transforming a watermark-embedded audio data and an original audio data to generate first components and second components respectively;

Wavelet transforming the absolute magnitudes of said first components of said watermark-embedded audio data and said original audio data respectively;

taking the differences between wavelet-transform coefficients of said watermark-embedded audio data and said original audio data; and

inverse-discrete cosine transforming said differences.

16. The method for extracting a watermark from a watermark-embedded audio data as claimed in claim 15, further comprising a step of multiplying the sign of said wavelet-transform coefficients associated with said original audio data to wavelet-transform coefficients associated with said watermark-embedded audio data.

17. The method for extracting a watermark from a watermark-embedded audio data as claimed in claim 16, wherein said multiplying step further comprises a

step of multiplying a scaling factor to wavelet coefficients associated with said watermark-embedded audio data.

18. The method for extracting a watermark from a watermark-embedded audio data as claimed in claim 16, wherein said sign is obtained by using a signum function.

19. The method for extracting a watermark from a watermark-embedded audio data as claimed in claim 17, wherein said scaling factor is in the range of 20 ~ 100.

20. An apparatus for extracting a watermark from a watermark-embedded audio data, comprising:

a means for Fourier transforming a watermark-embedded audio data and an original audio data to generate first components and second components respectively;

a means for wavelet transforming the absolute magnitudes of said first components of said watermark-embedded audio data and said original audio data respectively;

a means for taking the differences between wavelet-transform coefficients of said watermark-embedded audio data and said original audio data; and

a means for inverse-discrete cosine transforming said differences.

21. The apparatus for extracting a watermark from a watermark-embedded audio data as claimed in claim 20, further comprising a means for multiplying the sign of said wavelet-transform coefficients associated with said original audio data to wavelet-transform coefficients associated with said watermark-embedded audio data.

22. The apparatus for extracting a watermark from a watermark-embedded audio data as claimed in claim 21, further comprising the means for multiplying a scaling factor to wavelet-transform coefficients associated with said watermark-embedded audio data.

23. The apparatus for extracting a watermark from a watermark-embedded audio data as claimed in claim 21, wherein said sign is obtained by using a signum function.

24. The apparatus for extracting a watermark from a watermark-embedded audio data as claimed in claim 22, wherein said scaling factor is in the range of 20 ~ 100.

ABSTRACT OF THE DISCLOSURE

Digital watermarking of digital audio is performed by Fourier transforming digital audio data, wavelet transforming the magnitude components of the Fourier transform coefficients of the digital audio data, discrete cosine transforming a watermark signal, multiplying the sign of the wavelet transform coefficients of the magnitude components to the coefficients of the discrete cosine transformed watermark signal, adding the coefficients of the Fourier transformed digital audio data and the adjusted discrete cosine transformed watermark signal, and inverse wavelet transforming the audio signal's coefficients before inverse Fourier transformation to finally generate watermark-embedded audio signal data.

Fig. 1

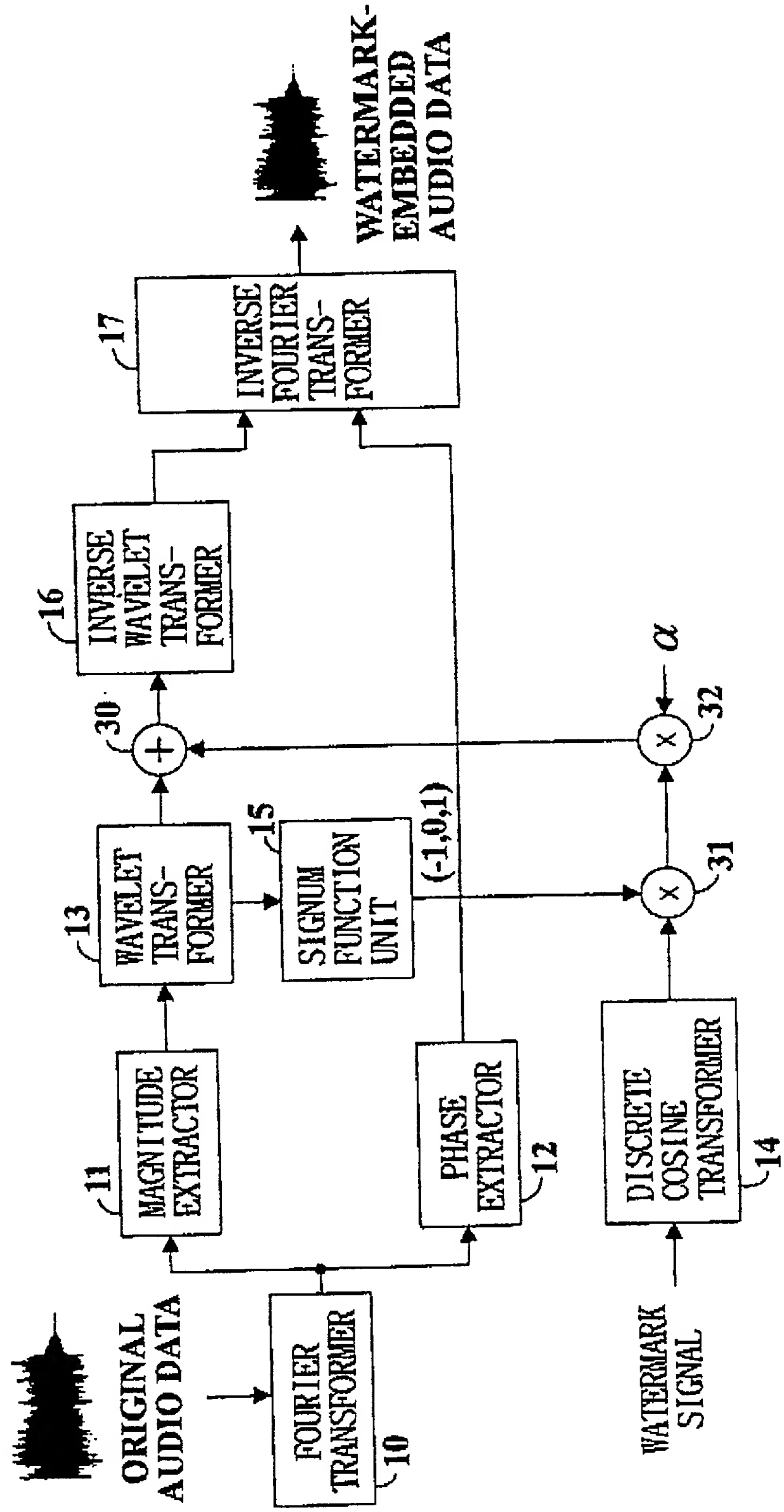
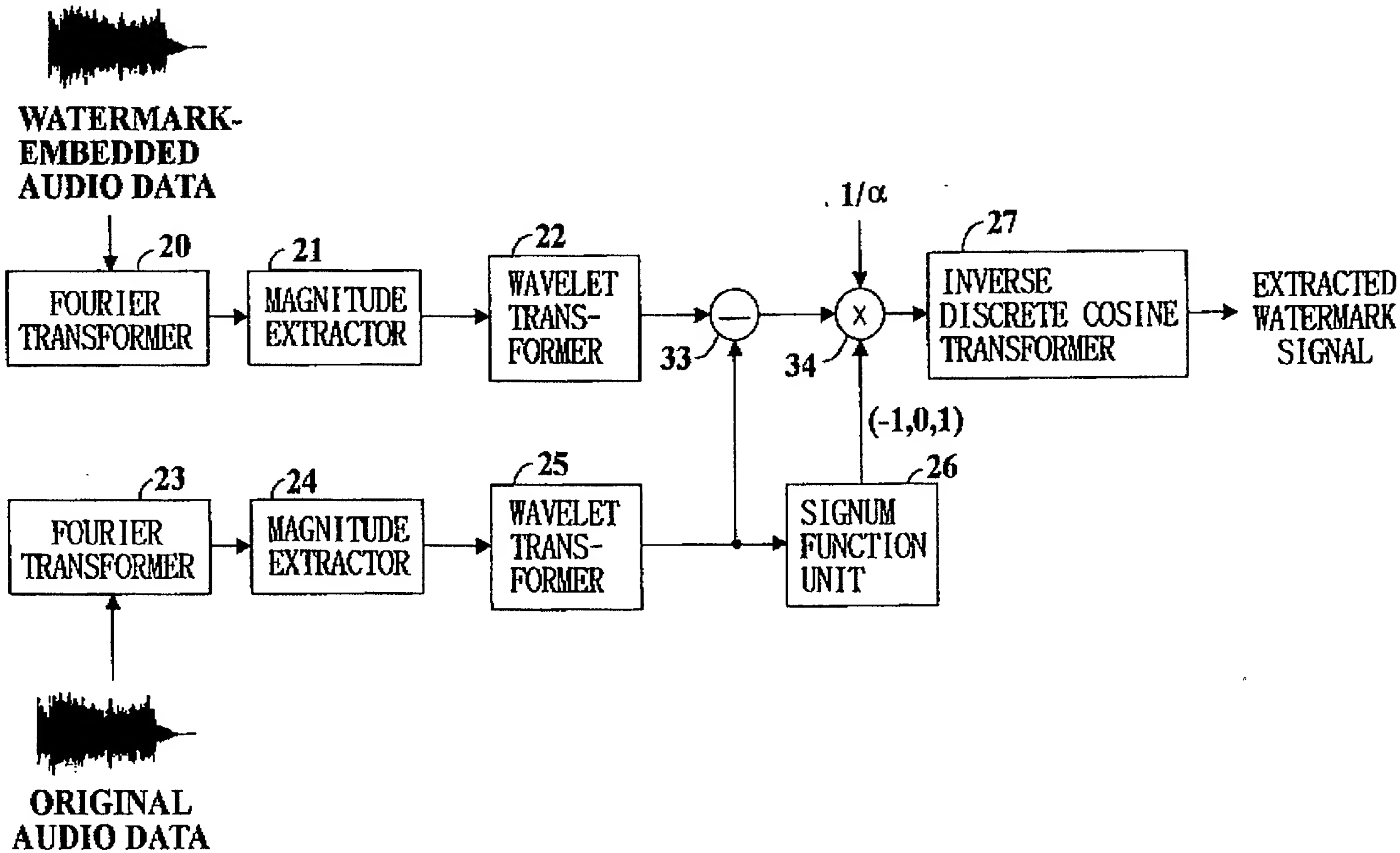

ORIGINAL AUDIO DATA
FOURIER TRANSFORMER
10
MAGNITUDE EXTRACTOR
11
PHASE EXTRACTOR
12
WAVELET TRANS-FORMER
13
DISCRETE COSINE TRANSFORMER
14
SIGNUM FUNCTION UNIT
15
(-1,0,1)
30
31
32
α
WATERMARK SIGNAL
INVERSE WAVELET TRANS-FORMER
16
INVERSE FOURIER TRANS-FORMER
17
WATERMARK-EMBEDDED AUDIO DATA

Fig. 2


WATERMARK-EMBEDDED AUDIO DATA
20
FOURIER TRANSFORMER
21
MAGNITUDE EXTRACTOR
22
WAVELET TRANS-FORMER
33
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34
27
INVERSE DISCRETE COSINE TRANSFORMER
EXTRACTED WATERMARK SIGNAL
23
FOURIER TRANSFORMER
24
MAGNITUDE EXTRACTOR
25
WAVELET TRANS-FORMER
(-1,0,1)
26
SIGNUM FUNCTION UNIT
ORIGINAL AUDIO DATA

Declaration and Power of Attorney For Patent Application
특허 출원 관련 선언 및 위임권
Korean Language Declaration

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I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

DIGITAL WATERMARKING METHOD AND APPARATUS

본 발명의 명세서는

the specification of which

☐ 여기에 첨부됩니다.
☐ 미합중국 출원번호 또는 PCT 국제 출원번호는
_____ 로
_____ 일에 출원되었고
_____ 일에 개정되었음(해당경우)

☒ is attached hereto
☐ was filed on _____
as United States Application Number or PCT International Application Number
_____ and was amended on
_____ (if applicable).

본인은 상기 개정에 의해 수정된 상기 명세서는 물론 특허 청구의 내용을 검사했으며 이해했음을 확인합니다.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

본인은 연방 규정 코드인 제37장의 제1.56항에 의거하여 특허 자격에 관한 자료 정보를 공개할 의무를 인정합니다.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

Korean Language Declaration

본인은 외국인 특허 출원(들)이나 발명자의 증명서 관련 경우에는 미합중국 코드인 제35장의 제119(a)-(d)항이나 제365(b)항에 의거하여 또는 미합중국 이외에 적어도 한 국가를 지정하는 PCT 국제 출원의 경우에는 제365(a)항에 의거하여 하기 명시된 특허 출원의 외국 우선권을 주장하며, 외국인 특허 출원, 발명자 증명서 또는 우선권이 주장되는 출원일 이전에 제출된 PCT 국제 출원도 또한 아래에 해당란을 체크함으로서 확인하였습니다.

I hereby claim foreign priority under Title 35, United States Code, §119 (a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certification, or §365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s) 외국인 선행 출원			Priority Claimed 우선권 주장	
1999-10821	Koera	29/March/1999	X	
(Number) (번호)	(Country) (국가)	(Day/Month/Year Filed) (출원일자 일/월/년)	Yes 네	No 아니오
2000-15406	Korea	27/March/2000	X	
(Number) (번호)	(Country) (국가)	(Day/Month/Year Filed) (출원일자 일/월/년)	Yes 네	No 아니오

본인은 미합중국 코드인 제35장 제119항(e)에 명시된 바와 같이 하기 미합중국 가출원에 관련된 특권을 요구합니다.

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

(Application No.) (출원 번호)	(Filing Date) (출원 일자)	(Application No.) (출원 번호)	(Filing Date) (출원 일자)

본인은 미합중국 코드인 제35장의 미국인 출원(들) 관련 제120항에 명시된 바와 같이 또는 미합중국을 지정하는 PCT 국제 출원 관련 제365(c) 항에 명시된 바와 같이 하기 출원의 특권을 요구합니다. 이 출원서에 있는 각 특허 청구의 내용이 미합중국 코드인 제35장 제112항의 첫번째 절에서 명시된 바와 같이 증전의 미국 또는 PCT 국제 출원에 발표되지 않았으면 본인은 연방 규정 코드인 제37장 제1.56항에 명시된 바와 같이 증전 출원일자와 이 출원서의 국내 또는 PCT 국제 출원일자 사이에 특허 자격에 대한 자료 정보를 공개할 의무를 인정합니다.

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s), or §365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application

(Application No.) (출원 번호)	(Filing Date) (출원 일자)	(Status: Patented, Pending, Abandoned) (현황 특허 획득, 출원중, 포기)
(Application No.) (출원 번호)	(Filing Date) (출원 일자)	(Status: Patented, Pending, Abandoned) (현황 특허 획득, 출원중, 포기)

본인이 아는 한도 내에서 여기에 제공된 모든 내용이 사실이고, 제공된 정보나 소신이 모두 사실임을 확인하며, 더나아가 미합중국 코드 제18장의 제1001절에 명시된 바와 같이 고의의 허위 진술 및 이와 유사한 행위는 벌금이나 투옥으로 처벌 받거나 벌금과 감옥형을 모두 받을 수 있고 이러한 고의의 허위 진술은 특허 출원이나 후에 발급된 특허의 유효성을 위태롭게 함을 인지하면서 여기에 진술함을 선언합니다.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon

Korean Language Declaration

위임권: 지명된 발명자로서 본인은 이 특허를 출원하고 이와 관련하여 특허 및 상표청이 요구하는 실무를 처리하기 위해서 하기 변호사(들) 및/또는 대리인(들)을 임명합니다. *(성명 및 등록번호 기입)*

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: *(List name and registration number)*

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(Supply information and signature for third and subsequent joint inventors.)

Korean Language Declaration

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만약 있으면 여섯번째 공동 발명자의 이름	Full name of sixth joint inventor, if any
여섯번째 발명자의 서명 일자	Sixth Inventor's signature Date
거주지	Residence
국적	Citizenship
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(세번째 이상의 공동 발명자에 대한 같은 내용의 정보 및 서명 첨부) (Supply similar information and signature for third and subsequent joint inventors.)